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Palaeoenvironmental changes recorded in the palynology and palynofacies of a Late Permian Marker Mudstone (Galilee Basin, Australia)

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Abstract

Reconstructing the terrestrial palaeoenvironment during the end-Permian is made challenging by widespread erosion and ecosystem destruction. High-resolution sampling for palynofacies and palynology in sections that preserve the boundary interval allows for detailed examination of the drastic environmental changes that characterize the Permian–Triassic mass extinction. In the Bowen and Galilee basins in eastern Australia, this environmental perturbation is recorded within a Marker Mudstone that occurs above the uppermost Permian coal seams. The Marker Mudstone is used as a stratigraphic reference level at many localities, but has previously only been studied at a single locality in the Bowen Basin. In the present study, borehole Tambo 1-1A drilled in the Galilee Basin was selected to clarify whether this black, organic-rich mudstone marks a marine transgression, and to examine potential indicators of the end-Permian mass extinction. A total of 22 samples were taken from the mudstone unit, and from the over- and underlying strata and processed for palynology, palynofacies, and carbon isotope analysis.

Biostratigraphic data indicate that the Marker Mudstone itself covers the uppermost part of unit APP5, with the first index taxa of unit APP6 floras occurring in samples less than 80 cm above this interval. This can be correlated with several other localities in the Bowen and Sydney basins where this shift occurs just above the uppermost Permian coal seam. Palynofacies data agree with previous interpretations of a southwards prograding delta that subsides as base level rises to form an extensive waterbody in which the Marker Mudstone was deposited. A change from translucent phytoclast-dominated to opaque phytoclast-dominated palynofacies within the Marker Mudstone suggests a shift to more oxic conditions in the water column, while base level begins to fluctuate, or increased terrestrial input from fluvial systems as the hinterland rises. Algal bodies resembling *Botryococcus* are found in the strata above the Marker Mudstone, but differ in morphology from the algal bodies found in the deltaic facies below. The presence of acanthomorph acritarchs in the Marker Mudstone and in the overlying Rewan Formation may indicate marine influence. Forms resembling fungal spores are present, but they do not show a "spike" as seen in other P–T boundary localities.

The relative position of unit APP6 to the P–T boundary itself remains unclear. APP6 assemblages are dominated by simple acavate trilete and cavate trilete spores, which suggests stressed environment dominated by ferns and lycopods. The presence of degraded phytoclasts towards the top of the Marker Mudstone may also be used to suggest a mass-extinction interval. They may also be indicative of shifting local palaeoenvironmental changes, an interpretation that is supported by the low magnitude negative excursion of the $\delta^{13}C$ isotope values within the Marker Mudstone. More datasets from the Bowen and Galilee basins will be essential to decoupling these signals.

Keywords: Palynology; Palynofacies; Carbon isotopes; Palaeoenvironment; Permian–Triassic boundary; Galilee Basin

1. Introduction

Deciphering patterns and processes of environmental change across the Permian–Triassic boundary in the terrestrial basins of Gondwana has long been a challenge (e.g., de Wit et al., 2002; Gastaldo et al., 2009; Smith and Botha-Brink, 2014). In eastern Australia, integrated palynological and geochronological studies have shown great utility for dating and correlating the late Permian deposits (Smith and Mantle, 2013; Laurie et al., 2016). Potential sections in the Galilee Basin in particular have remained understudied when compared to those of other eastern Australian basins such as the Bowen, Gunnedah and Sydney

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